Appendix C
Waste Generation Calculations

Waste generation rates used in this report are based on tonnage figures provided by recycling coordinators and other local officials, who may have estimated the data or relied on other sources, such as private haulers. In several cases, communities measure materials in cubic yards and use conversion factors to calculate tonnage figures. ILSR staff have estimated tonnage recovered, using commonly accepted conversion factors, in a few instances when communities did not calculate tonnage figures. (The Sample Conversion Factors in this appendix lists all conversion factors used.) Waste figures may at times exclude untracked components of the waste stream. For example, residential waste handled by the private sector is sometimes excluded from residential figures. See ILSR's *In-Depth Studies of Recycling and Composting Programs: Designs, Costs, Results* for further information on how tonnage figures were derived. The following table provides a community-by-community summary of which figures were estimated and how, and what, if any, component of the waste stream maybe excluded.

Community	Description of Assumptions and Estimates Made for Calculating Waste Generation, and Identification of Any Untracked Waste Stream Components
Austin, TX	Total waste disposed is based on an average state waste generation rate of 6.2 pounds of residential, commercial, and C&D waste per person per day (provided by the Texas Department of Health). While the City tracks tonnage figures of waste disposed from single-family households, duplexes, and three- to four-unit buildings (excluding bulky items such as furniture and tires), it does not track the tonnage disposed from condominiums, apartment buildings with more than four units, from commercial and institutional establishments, or from construction and demolition sites. Waste generated from buildings with more than four units (64,652 households~ percent of total) is based on the following City of Austin statistics and estimates: 2.2 persons per household and 2.35 Ibs./capita/day. The tonnage of Christmas trees recovered is not tracked and thus is excluded from waste generation and recovery figures. Recycled tonnage represents marketed material.
Berkeley, CA	MSW generation figures provided by the City of Berkeley are based on 1988-89 annual date estimated from quarterly waste composition samplings. Because no major demographic or economic changes occurred in Berkeley between 1989 and 1990, the City believes there has been no significant change in waste generation rates. Figures for waste recovered are actual tonnage figures for FY 1991. MSW recycled tonnage represent marketed material. Annual tonnages of concrete and asphalt recovered were estimated from 6 months worth of data. The City does not separately track residential and commercial/institutional material.
Berlin Township, NJ	Total MSW is based on a per capita waste generation rate of 0.6 tons per year, which is based on actual waste sampling undertaken at the Township's local landfill. The tonnage of commercial waste generated is untracked and is estimated by subtracting residential waste figures from total MSW. Berlin Township estimates wood waste and brush using conversion factors of 5.5 cubic yards/ton for wood waste and 8.0 cubic yards/ton for brush. The figures for grass clippings mulched is based on a conversion factor of 2.7 cubic yards/uncompacted ton. The tonnage of leaves composted is based on conversion factors of 2 cube yards/ton of compacted leaves and 2.86 cubic yards/ton of vacuumed leaves.
Boulder, CO	Although the City of Boulder does not track actual tonnages of waste disposed, the private contractor handling 80% of the City's MSW and C&D disposed does track tonnages. Citywide figures are based on 125% of the contractor's tonnages. Some of the materials collected at supermarkets for recycling are not tracked and thus excluded from waste generation and recovery figures. The tonnage of brush chipped and recovered is based on a conversion factor of 300 lbs./cubic yard. The tonnage figure for food waste recovered is based on a conversion factor of 900 lbs./cubic yard. The tonnage of Christmas trees is based on 20 lbs./tree. Recycled tonnages represent collected material.

Bowdoinham, ME	The Bowdoinham Town Solid Waste Manager estimated the tonnage of MSW disposed from cubic yards using a conversion factor of 250 lbs./cubic yard, which was based on weighing a 1-cubic-yard pallet box of refuse three times during 1990. The tonnages of leaves and grass dippings composted are based on a conversion factor of 500 lbs./cubic yard. The tonnage of recyclables includes 43 tons of deposit containers, based on a State estimate that 7% of total waste generated is recovered through the State bottle bill. Recycled tonnage represents recycled materiel. Because MSW contains material from only 15 businesses, Bowdoinham's MSW data is frequently used in this report in lieu of residential figures, which are unavailable.
Columbia, MO	MSW figures are not available as C&D material is not tracked separately from commercial/institutional waste. Tonnage figures for waste landfilled are extrapolated from the results of a 4-week weighing period in August 1989. While curbside recycling tonnages are tracked, the tonnages of residential waste recovered through drop-off sites, deposit containers, and recyclables collected from the commercial sector are based on a study by a private consultant. The tonnage of Christmas frees collected at curbside for recovery, and of grass clippings and leaves dropped off by residents and landscapers at the City's mulch site are untracked and thus excluded from waste generation and recovery figures. The tonnage of 39,000 pallets recovered were estimated by a private consultant, who used a conversion factor of 30 lbs./pallet.
Dakota County, MN	C&D disposed end recovered is not available. Landscaping waste recovered cannot be broken down into residential and commercial/institutional but is included under total MSW. MSW includes tires. The tonnage of the 1,080 Christmas trees recovered by private haulers is based on a County estimate of 15.1 lbs.tree.
Fennimore, WI	MSW does not include bulky items such as tires and appliances. C&D is not tracked. Recycled tonnage represents collected material. Grass dippings, some leaves, garden waste, and food scraps-which are dropped off by residents—are composted together; tonnages are based on a conversion factor of 102 lbs./cubic yard. The tonnage of leaves collected at curbside is estimated by ILSR staff using a conversion factor of 350 lbs./cubic yard and using estimates by the City that there were 48 truckloads of leaves in 1981) and 7.5 cubic yards/truck.
King County, WA	The Washington State Department of Ecology provided MSW waste recovered and disposed tonnage figures for King County. (ILSR excluded 102,850 tons of ferrous scrap such as auto hulks that did not qualify as C&D or MSW.) C&D waste figures are not available as this waste is handled by the private sector. The County estimated the tonnages of residential, commercial/institutional, and self-hauled waste disposed by assuming 10% of total MSW disposed was from self-haul sites, and 80% of the remaining tonnage was residential. Recycled tonnage typically represents marketed material.
La Crescent, MN	Bulky items disposed such as furniture are included with residential waste landfilled. Tires, collected for recovery, are burned; tonnages are included with residential waste incinerated. The tonnages of grass clippings and leaves composted are based on weights of grass clippings and leaves measured separately for 2 weeks in summer and in fall, the percent of participating households in the drop-off program, and the total number of households. Recycled tonnage represents marketed material.
Lafayette, LA	C&D is not tracked. Tires are included in waste disposed. Lafayette bases its yard waste tonnages on a conversion factor of 500 lbs./cubic yard. Commercial/institutional recyclables contain a small amount of residential material recovered through drop-off sites. Other commercial materials are recovered but not tracked (white goods, motor oil, batteries, and scrap metal, plus old corrugated cardboard from many supermarkets). Recycled tonnage represents marketed material.
Lincoln, NE	Some yard waste is self-hauled to a transfer station for composting; this tonnage is included in total MSW but not in residential or commercial/institutional. Tires are included in residential and commercial waste disposed. The tonnage of recyclables are extrapolated from 1990 Lancaster County tonnage data. The Lincoln Office of Recycling estimates that 85% of the recyclables recovered in Lancaster County are from the City of Lincoln. Recycled tonnage represents collected material.

Lincoln Park, NJ	Residential tonnage recovered includes some commercial material brought to the drop-off sites and excludes 99 tons of recyclables collected by a private hauler from two condominiums. This latter tonnage is included under commercial/institutional waste, as is the corresponding waste disposed. Tires are included in residential and commercial/institutional waste recovered. Recovered tonnage excludes waste paper recycled by a printer as this material did not meet our definition of MSW. The Borough uses a combination of conversion factors and actual weight samples to determine tonnages of yard waste. Conversion factors are 35 bags/ton of bagged leaves, 2.86 cubic yards/ton of vacuumed leaves, 2 cubic yards/ton of compacted leaves, 8 cubic yards/ton of stumps and logs, and 4 cubic yards/ton of wood chips. Recycled tonnage represents collected material.
Mecklenburg County, NC	Bulky items and tires are included in MSW. C&D is not available. Less than 4% of residential recyclables is actually commercial waste collected at County drop-off sites. Hurricane Hugo greatly increased 1990 composting figures; FY 89 tonnage composted at drop-off sites is used and extrapolated from compostables collected and weighed during a 7-month period. Recycled tonnage represents marketed material.
Monroe, WI	Residential waste excludes waste from approximately 371 households (8% of total households) in buildings with three or more units. The tonnage of recyclables collected through the drop-off was estimated by the City and is included in residential waste figures. C&D tonnages are based on data provided by the largest commercial hauler and on the City's data that the hauler collects 70% of its C&D waste. Recycled tonnage represents marketed material.
Naperville, IL	Residential waste figures represent waste handled by the public sector only, which services one-to four-unit households and condominiums. Residential waste excludes material generated by 6,500 multi-unit households (21% of total households). Recyclables delivered to the drop-off by multi-unit households, businesses, and some other residential sources, are not included in residential waste figures. Commercial/institutional waste disposed and recovered is not tracked and are unavailable. The tonnage of leaves composted was estimated by the City based on volume amounts. The tonnage of Christmas trees was estimated by ILSR staff, based on 20 lbs./tree. Recycled tonnage represents collected material.
Newark, NJ	Public sector figures exclude large multi-unit buildings served by private haulers and include a small amount of material from the commercial sector collected at the municipal drop-off site. Private sector figures include multi-unit buildings and some C&D. The figures for waste recovered and generated do not include 147,176 tons of metal scrap reported as recovered by private haulers because this tonnage could not be confirmed as part of Newark's municipal solid waste or C&D stream. The City of Newark calculated the tonnage of yard waste composted using a conversion factor of 8 cubic yards/ton and the tonnage of brush and Christmas trees composted using a conversion factor of 4 cubic yards/ton.
Perkasie, PA	Only tonnage figures for waste handled by the public sector are available. This is largely residential waste and excludes waste generated by condominiums and apartments, but includes refuse and recyclables from 15 small businesses served by DPW. Some bulky waste (such as mattresses and furniture) is included in residential waste figures, but tires and appliances, which are disposed by a private hauler, are not. C&D debris is not tracked. ILSR staff estimated the tonnage of brush, leaves, and Christmas trees Perkasie composts and chips based on volume amounts and the following conversion factors: 4 cubic yards/ton of brush, 350 lbs/uncompacted cubic yard of leaves, and 20 lbs./Christmas tree.
Peterborough, NH	Waste generation and recovery figures are based on tonnage data from the Town Recycling Center and the hauler serving both the commercial/institutional sector and 80% of those residents who do not use the Center. The breakdown of the Center's materials into residential and commercial/institutional figures is based on estimates by the Recycling Coordinator that 95% of recyclables and refuse are residential. The City's hauler also collects C&D waste; tonnage figures for this waste were based on volume amounts using 364 lbs./cubic yard.
Philadelphia, PA	Municipal solid waste can only be broken down into publicly collected waste and privately collected waste. Public sector materials recovered are from 33% of all households up to six units in size, from block corners, drop-off sites, municipal office buildings, and from City leaf collection programs. Waste disposed is collected from 524,505 single-to six-unit households, businesses with less than six employees, and from municipal street sweepings. Private haulers serve households with seven or more units and the commercial/institutional sector. Materials self-hauled to landfills are included with private sector figures. The tonnage of recyclable materials self-hauled to drop-off centers or private scrap yards is not tracked and thus not included in waste generation and recovery figures. Motor oil is collected throughout the city for recovery; tonnages are also unavailable. Leaves and Christmas trees recovered are not weighed. Tonnage figures are estimated by the City, based on the total number of trucks delivering leaves to the composting site.
Portland, OR	Tonnages of waste recovered were calculated by City Recycling Office based on per capita recycling averages for the metropolitan region. MSW includes deposit containers and bulky items such as white goods and wooden pallets but excludes tires and construction debris. The tonnage composted represents source-separated yard waste composted and does not include waste composted through the City's mixed waste composting facility in 1880. Recycled tonnage represents marketed material.

Providence, RI	Residential waste recycled and disposed includes only materials collected from one-to six-unit buildings and public housing, and excludes refuse and recycables from buildings greater than six units (tonnage for which is not tracked and thus not included in waste generation and recovery figures). Commercial/institutional waste disposed and recovered was estimated from 34 establishments that submitted recycling reports to the State. C&D waste is not tracked. Recycled tonnage represents collected material.
San Francisco, CA	Residential materials recovered include recyclable materials collected at curbside, through drop-off and buy-back centers, and some bulky items self-hauled to the transfer station. Other recyclables self-hauled to the transfer station are included in MSW but cannot be broken down into residential and commercial/institutional. Much of the data comes from a waste composition study of the City's waste stream by a consulting firm.
Seattle, WA	Commercial/institutional figures for waste recycled are based on City extrapolations from 1988 actual tonnages. Materials self-hauled to the City's transfer stations are included in MSW but cannot be broken down into residential and commercial/institutional. C&D waste disposed is not tracked. Recycled tonnage represents marketed material.
Sonoma County, CA	MSW includes most bulky items such as white goods, office furniture, and tires. The tonnage of tires recycled is estimated based on the County Recycling Coordinator's estimate that 30% of tires recovered are retread or reused, and 70% are incinerated. ILSR used a conversion factor of 20 Ibs/tire to calculate tonnage. Recycled tonnage represents collected material.
Takoma Park, MD	Only waste generation and recovery figures handled by the public sector, which is largely single-family residential waste, are available. Residential waste figures include buildings of 12 units or less (2,936 households are in buildings greater than 12 units--42% of total households.) The City Recycing Coordinator estimated the tonnage of leaves composted based on the number of full truckloads of leaves, the number of days leaves were collected, and a conversion factor of 500 lbs./cubic yard. Recycled tonnage represents collected material.
Upper Township, NJ	Waste generation and recovery figures can only be broken down into publicly collected materials and privately collected materials. Public sector figures include recyclable materials from 3,780 single-family households, 80 households in duplexes, and 222 businesses. Public sector waste disposed excludes the 222 businesses, this wash is handled by the private sector. Private sector materials include C&D waste. Recycled tonnage represents collected material.
Wapakoneta, OH	MSW figures cannot be broken down into residential and commercial/institutional. MSW excludes bulky items such as tires and wood waste. C&D waste is untracked. MSW recycled includes a small amount delivered to the recycling center by out-of-town residents. The City estimated the tonnage of refuse and recyclables collected from businesses by the private sector. Tonnages of yard waste composted were estimated by the Ohio EPA and the City.
West Linn, OR	MSW figures are based on the former City Recycling Coordinator's estimate that 80% of total waste is MSW. MSW waste disposed cannot be broken down into residential and commercial/institutional. Figures include waste disposed and recovered from 80 households on the outskirts of West Linn and bulky items such as white goods. Per capita residential waste generation rates have been calculated using an estimate provided by the former Recycled Coordinator that 87% of MSW disposed is residential material. C&D is based on the former City Recycling Coordinator's estimate that 20% of total waste is C&D, and that 30% of this is recovered.
W. Palm Beach, FL	Waste generated includes bulky items such as tires and furniture. Tonnage recovered by private buy-back centers and swap yards is not tracked and thus not included in waste generation and recovery figures. Recycled tonnage represents marketed material.

Sample Conversion Factors

MIXED MSW (compacted)

Conversions Used By Communities:

785 lbs/cy (0.39 tons/cy) or 2.55 cy/ton
Source: *Solid Waste Management Plan Revision,* Sonoma Co., CA, May 1990.

1 ton/3.2 cy or 1 cy/625 lbs.
Source: Naperville, IL

Conversions Found in the Literature

500-700 lbs/cy (0.25 -0.35 tons/cy) or 2.8-4 cy/ton
Source: *Solid Waste Data: A Compilation of Statistics on Solid Waste Management Within the United States,* US EPA, August, 1981.

600 lbs/cy (0.3 tons/cy) or 3.3 cy/ton
Source: *Association of New Jersey Recyclers (AN]R), Directory,* 1987.

MIXED MSW (uncompacted)

200 lbs/cy
Source: *Solid Waste Data: A Compilation of Statistics on Solid Waste Management Within the United States,* US EPA, August 1981.

MIXED YARD WASTE (average compaction)

Conversions Found in the Literature:

600 lbs/cy
Source: *Yard Waste composting,* US EPA, April 1989.

Conversions Used By Communities:

620 lbs/cy
Source: Recycled Wood Products, Berkeley, CA

650-750 lbs/cy
Source: Portland, OR

660 lbs/cy
Source: West Palm Beach, FL

MIXED YARD WASTE (loose)

200-250 lbs/cy or 9 cy/ton
Source: Portland, OR

LEAVES (average compaction)

500 lbs/cy (320 - 500 lbs/cy)
Source: *Yard Waste Composting — A Study of Eight Programs,* US EPA, April 1989.

450 lbs/cy
Source: *AN]R Directory,* 1987.

1,000 lbs/cy
Source: New Jersey Department of Environmental Protection

LEAVES (vacuumed)

700 lbs/cy
Source: New Jersey Department of Environmental Protection

LEAVES (loose)
250-350 lbs / cy
Source: *ANJR Directory, 1987.*

CHIPPED BRUSH
500 lbs / cy
Source National Recycling Coalition, 1989

COMPOST (finished)
1,500 lbs / cy
Source: *Yard Waste Composting,* US EPA, April, 1989.

CHRISTMAS TREES
20 lbs / tree
Source: *Summary of County-Wide Christmas Tree Recycling Project 1990-1991,* Garbage Reincarnation, Inc., Sonoma Co., CA.

15.1 lbs / tree
Source: Dakota County, MN

FOOD WASTE
500 lbs / cy (residential)
800-1000 lbs / cy (commercial)
Source: Suhr, J.L., Higgins, A.J. and Derr, D.A., *Feasibility of Food Waste Recycling in New Jersey: Fourth Quarterly Report to the Office of Recycling,* 1984.

900 lbs / cy (commercial)
Source: *Asheville/Buncombe County Solid Waste Alternatives: Planning Workbook,* ILSR, March 1985.

GRASS CLIPPINGS (Compacted)
1,090 lbs / cy
Source: Naperville, IL

1,050-1,110 lbs / cy
Source: New Jersey Department of Environmental Protection

WATER
8.345 lbs / gal
Source: Lindeburg, Michael R., *Engineering Unit Conversions, 2nd ed.,* 1990.

USED MOTOR OIL
7 lbs / gal (6.5 -7.5 lbs / gal)
Source: *ANJR Directory,* 1987. Range was arrived at by converting API gravity for 25-50% crude oil to specific gravity *(Perry's Chemical Engineers' Handbook, 6th ed.).*

CONCRETE/ASPHALT (broken)
1.5 tons / cy
Source: American Rock and Asphalt, Richmond, CA.

MIXED WOOD WASTE (C&D)
364 lbs. / cy
Source: New Jersey Department of Environmental Protection